

other measures to observe any sudden fall in temperature approaching the danger point. With better protective facilities and a better knowledge of the requirements for successful culture confidence is increasing, resulting at present in a phenomenal extension of the acreage in young groves.

XIII.

FROSTS AND FROST PROTECTION IN TEXAS.

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In considering the subject of frosts and frost protection in Texas, the great diversity of climatic conditions which exist within the limits of the State must be referred to.

In the coast section, which borders the Gulf of Mexico for a distance of 350 miles, climatic conditions are largely influenced by the warm waters of the Gulf. The winters are mild and short, the annual and diurnal ranges of temperature are small, and cold spells are followed by extended periods of damp, foggy weather. The cold periods are of short duration and are rarely severe enough to kill the more hardy vegetation. Truck growing is most profitably carried on during the winter months, and large areas are devoted to sugar cane, strawberries, and citrus fruits. In this coastal section an unexpected freeze causes immense loss and the growers are prepared to protect their crops. Strawberries and truck are injured by frosts, but sugar cane and citrus fruits will withstand a temperature several degrees below freezing.

In central and northern Texas there are some orchards, but, so far as known, little effort has been made to protect from injury by frost. Not much farming is done in this part of the State during the winter months. Corn, cotton, and small grain are the principal crops. A late frost in spring kills early planted corn and cotton, but the area devoted to these crops is so large that no protection can be given. Late cotton and the "top crop" are sometimes killed by unusually early frosts in autumn. Warnings of severe weather conditions are of great value to shippers and stockmen in this section, but are not so much used by farmers.

East Texas is wooded, and the climate is moist and well adapted to small fruits and early spring truck. There are large commercial peach orchards and tomato farms in this section. A late frost in spring may destroy the peach crop and delay the tomatoes so that they will reach northern markets too late to be sold at a profit. Many of the growers have made arrangements to protect against frosts and freezes; warnings are of greatest value from the middle of February throughout the spring months.

In west Texas and the panhandle the climate is continental in character, with hot summers and cold winters, and the cold waves are more frequent and severe. Stock raising and the growing of small grain are the principal industries. Commercial orchards are being developed in the Rio Pecos Valley and in portions of the panhandle, resulting in an increasing demand for frost and cold-wave warnings. Frost warnings are of greatest value after

March 1; warnings of cold waves are needed by stockmen throughout the winter.

In extreme northwest Texas the first killing frost of autumn usually occurs during the last decade of October, but has been recorded as early as September 26. The last killing frost in spring usually occurs in April, but has been recorded as late as May 7.

In going southeastward the growing season gradually lengthens, until in the lower coast section the average date of the first killing frost in autumn is late in December and of the last killing frost in spring early in February; but there have been winters without freezing temperatures. On account of the high winds and dry air that attend the cold waves that reach the coast, freezing temperatures are more frequent in this section than killing frosts.

Frosts in Texas rarely occur on the first morning of a cold wave, but are probable on the second and third mornings if the temperatures continue low and the winds become light. They occur at a higher temperature in east Texas and the coast section than in central and west Texas.

It is only recently that systematic efforts have been made to protect crops from cold waves and freezes. In the peach orchards and trucking districts of east Texas orchard heaters and smudge pots have been used to some extent with satisfactory results. The cane grower, upon receipt of warnings, cuts and windrows his cane, which would have been a total loss if allowed to freeze before cutting. Strawberries are usually protected by covering with a mulch of straw or hay which had been placed between the rows for this emergency. Between the cold spells the covering is removed. By using this precaution strawberries are marketed from the Houston-Galveston district from late in December to June 1.

In the trucking and citrus fruit district of south Texas smudge pots and heaters are used by many growers, while others build fires to the windward side of their fields. The great drawback in the use of artificial heat is the high wind that attends the Texas cold wave or "norther" during the first 12 to 36 hours after its arrival. It rapidly carries the smudge or heat beyond the limits of the area to be protected. To overcome this difficulty windbreaks are being planted in some sections. The smudge pots and heaters are effective, however, on the second or third night of the cold spells, when the wind has fallen and conditions are favorable for frost formation. Among other methods of protection against freezes are the covering of plants with soil and spraying and flooding. Flooding is found to be most efficient in the irrigated districts.

While the weather forecasts are published daily in the press and distributed by mail, telegraph, and telephone to our urban population, they formerly reached only a small percentage of the rural communities in time to be of benefit. Since the cooperation of the telephone companies of this State with the Weather Bureau, however, frost and cold-wave warnings are available to nearly every farmer, and the matter of protection is receiving increasing attention from the fruit and trucking interests. South Texas has a great future as a citrus fruit and winter truck-growing district, but to make these industries stable greater precautions must be taken to prevent the loss of a season's work by a frost or freeze.